

Report Number: DLA04-D024 **Report Date(s):** 10 September 2004

Previous Report Number: D024 **Previous Report Date:** NA

Title: Performance Oriented Packaging Testing of a 7-Gallon,
Steel, Open Head Drum, with 1-Quart Round, Metal Cans, Cone top,
(Qty of 6) for Liquids - Packing Group I, SG 1.2,
(All Modes of Transportation)

Responsible Individual: Francis S. Flynn

Performing Activity: LOGSA Packaging, Storage,
and Containerization Center
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Tobyhanna, PA 18466-5097

Performing Activity's Reference(s): TT 07-04; TT 10-03; TT 10-02;
9HTNR; AMC 13-88

Requesting Organization:
Defense Logistics Agency
Defense Distribution Center
ATTN: DDC-J-3/J-4-0
2001 Mission Drive
New Cumberland, PA 17070-5000

Requesting Organization's Reference(s):
DLA Memo, 23 Jan 04

Part 2. Test Results: ___ single X combination ___ composite

Section I. Pre-test Conditions

For initial testing, drums were received in new condition.

The following identification schema designates the packaging specimen used for the test(s) indicated. Each specimen is identified to the sample as procured from container manufacturer with the last four characters of this report no. preceding the specimen.

<u>Specimen</u>	<u>Test</u>
A,A1	repetitive-shock vibration test
A,A1	drop test:
	diagonal bottom chime at seam
	diagonal bottom chime at seam
	diagonal bottom chime at seam
	diagonal top chime
	flat side
	flat side
B1,B2,B3	hydrostatic pressure test
C	stack test

Prior to testing, each inner container was filled, unless otherwise noted, with tap water or a 50% solution of propylene glycol for plastic containers. Substitution for the actual hazardous item (material) is permitted by 49 CFR §178.602(c).

Section II. Summary

A. Drop test - 71"	PASS
B. Leakproofness test -	N/A
C. Internal pressure test/Hydrostatic pressure test (liq.) - Internal pressure tested to 150 kPa for air	PASS
D. Stacking test - 1,250 lbf, 24 hrs.	PASS
E. Vibration standard - 3.0 Hz, 1 hr.	PASS
F. Water resistance test (fiberboard box) -	N/A
G. Compatibility test (liq. in plastics) -	N/A

Part 2. Test Results (continued)

Section III. Discussion

A. Drop test: 49 CFR §178.603

Test date(s): 8/09/04

- ☐ cold conditioned (0° F, 72 hr)
☒ ambient conditions (72°F, 48% RH)
☐ standard conditions (23° C & 50% RH)

No.	Ht.	Orientation	Results
A1	71"*	Diagonal bottom chime at seam	Pass/No leaks/rupture; entire contents retained
A1	71"	Diagonal bottom chime at seam	Pass/No leaks/rupture; entire contents retained
A1	71"	Diagonal bottom chime at seam	Pass/No leaks/rupture; entire contents retained
A1	71"	Diagonal top chime	Pass/No leaks/rupture; entire contents retained
A1	71"	Flat side	Pass/No leaks/rupture; entire contents retained
A1	71"	Flat side	Pass/No leaks/rupture; entire contents retained

* Specimen A was tested at a drop height of 106.3" (PG I, SG 1.8) and FAILED, a can in the bottom layer leaked, dented cap. This configuration was then retested to PG I, SG 1.2 requirements per the requester.

For each orientation for the drop test, an overhead hoist, equipped with an electronic release, was used. The impact surface was a steel plate.

The decision to use the same container (configuration) for all six drop orientations was based on the relatively minimal damage demonstrated during previous testing of MS27684-5 drums with different inner containers or articles. Six drops per configuration exceeds 49 CFR §178.603 requirements, as well as both UN and ASTM recommendations (i.e., one drop on a side or circumferential chime per drum). The use of one configuration for multiple tests and drops is DOD policy as stated in DLAD 4145.41/AR 700-143/AFJI 24-210/NAVSUPINST 4030.55B/MCO 4030.40B, Packaging of Hazardous Material. Also per this policy, any failed orientation(s) can be repeated using another configuration.

B. Leakproofness test: 49 CFR §178.604

N/A. The leakproofness test of inner packaging is not required.

C. Internal Pressure/Hydrostatic Pressure test: 49 CFR §178.605
For transportation by air, 49 CFR §173.27, applies.

Test date(s): 6/15/04

No.	Pressure	Duration	Reached & Maintained Marked Pressure?
B1	100 kPa 150 kPa 250 kPa	5 min.	Yes Yes Yes
B2	100 kPa 150 kPa 250 kPa	5 min.	Yes Yes No, Failed at 250kPa, leaked at bottom chime
B3	100 kPa 150 kPa 250 kPa	5 min.	Yes Yes No, at 233kPa leaked at lid by bolt

The hydrostatic pressure test is conducted on metal drums intended for combination packagings used for air transportation.

Packing Group I hydrostatic pressure testing was requested to 250 kPa where as the manufacturer certifies the drums to 100 kPa. Three drums do not represent a statistically significant sample which brings into question the validity of using this data to designate these 7 gallon drums as acceptable for Packing Group I status. Hydrostatic pressure testing was performed on three specimen containers (DLA04-D017).

D. Stacking test: See 49 CFR §178.606. **Test date(s):** 6/19/04

☐ standard conditions (23° C & 50% RH)

☒ ambient conditions (74°F & 46% RH)

☐ high temperature conditions (104° F)

No.	Length	Type	Force Required	Actual Force Used	Results	Stability Maintained?
C	24 hr	Static	332 lbf	1,250 lbf	Pass	Yes

A static top load compression tester was used for the stack test, because it could hold the load constant for the required 24-hour timeframe. The total top load to be applied was greater than the minimum required for one drum based on the outside drum height and the gross packaged weight. The top load was to simulate a stack of identical packagings that might be stacked on the packaging during transport. Stack test was performed on one specimen container (DLA04-D013).

E. Vibration test: See 49 CFR §178.608.
ambient conditions (76°F & 50%RH)

Test date(s): 8/09/04

No.	Frequency	Duration	Results
A	3.1 Hz	1 hr	Not evaluated prior to further testing
A1	3.0 Hz	1 hr	Pass/No leakage, rupture, or damage

To be in compliance with U.S. Department of Transportation standards for packagings bearing the United States mark (USA) as a component of the packaging certification marking (49 CFR §173.24a(a)(5)), the vibration test was performed, as a means to determine capability. The test was conducted as prescribed by ASTM D 999, method A2 (Repetitive Shock Test (Rotary Motion)). The test was run for 1 hour, using the drum (outer) and an (inner container) combination packaging. The combination packaging was tested using a 1,250-lb vibration table (rotary motion) that had a 1-inch vertical double amplitude (peak-to-peak displacement) such that the combination packaging was raised from the platform to such a degree that a piece of steel strapping (1.6 mm) could be passed between the bottom of the package and the platform.

F. Water resistance (Cobb Method) test (fiberboard): N/A.

The Cobb Method Test, addressed in (49 CFR §178.516), Standards for Fiberboard Boxes, is a material specification test only for the fiberboard to be used for outer packagings.

G. Compatibility test (plastics packagings only): N/A

Compatibility testing (a procedure specified in appendix B to part 173, as required by 49 CFR §173.24(e)(3)(ii)) is only required for plastics packagings intended to contain *liquid* hazardous materials.

Part 3. Test Personnel

The following personnel performed the aforementioned testing, or had a role in the testing, evaluation, and/or documentation, as reported herein-- Richard D. LaFave, Charlotte Lent, and Timothy Reimann.

Part 4. References

A. Title 49 Code of Federal Regulations, Parts 106 and 180, current as of 1 Oct 03

B. International Air Transport Association Dangerous Goods Regulations, 45th edition, 2004

C. ASTM D 4919, Specification for Testing of Hazardous Materials Packagings.

D. ASTM D 999, Standard Method for Vibration Testing of Shipping Containers.

Part 4. References (continued)

E. ASTM D 951, Standard Test Method Water Resistance of Shipping Containers by Spray Method.

F. TAPPI Standard: T 441 Water Absorptiveness of Sized (Non-Bibulous) Paper and Paperboard (Cobb Test).

G. Recommendations on the Transport of Dangerous Goods, thirteenth revised edition, United Nations, New York, 2003.

H. DLAD 4145.41/AR 700-143/AFJI 24-210/NAVSUPINST 4030.55B/MCO 4030.40B, Packaging of Hazardous Material, 14 Jan 2000

I. AFIMAN 24-204/TM 38-250/NAVSUP PUB 505/MCO P4030.19G/DLAI4145.3, Preparing Hazardous Materials for Military Air Shipments, 11 Dec 01

Part 5. Equipment

Item	Manufacturer	Serial No.	Calibration Expiration Date
1,250-lb vibration table	L.A.B Skaneateles, NY	241121	see note
11,000-lb compression tester	Chant Engr. Co. New Britain, PA	001	4/05
500-lb scale	Ohaus Corporation USA	5097971	4/05
9,000-gram balance	Ohaus Corporation USA	20078	4/05
Release hook	Lansmont Monterey, CA	NA	N/R
Torque wrench (150 ft-lb)	Norbar Torque Tools Banberry, UK	2003/431074	10/04

Note. Equipment is calibrated in accordance with International Safe Transit Association test equipment verification requirements, ANSI/ISO 17025 (General Requirements for the Competence of Testing and Calibration Laboratories) and TB 43180 (Calibration and Repair Requirements for the Maintenance of Army Materiel).

Appendix A

Test Applicability

Pass/fail conclusions were based on the particular inner container and drum specimens, test loads, and the limited quantities submitted for test. Extrapolation to other materials, other manufacturers, other applications, different inner packagings, container sizes, or lesser inner quantities is the responsibility of the packaging design agency or applicable higher headquarters. Extrapolation of test results based on less than the minimum recommended number of test specimens is also the responsibility of the packaging design agency or applicable higher headquarters.

Reference to specification materials has been made based either on the information provided by the requester, the manufacturer, or the markings printed on, attached to, or embossed/molded on the packagings. It was not possible to identify the exact composition of the drum construction materials.

Testing was performed per *Title 49* Code of Federal Regulations.

Performance testing was undertaken and completed at the request of an agency responsible for shipment of the dangerous good(s). The completion of successful required performance tests does not, by itself, authorize the marking and transportation of the dangerous good(s). Applicable modal regulations should be consulted concerning the relationship of performance testing completed and the dangerous good(s).*

The required performance tests are intended to evaluate the performance of the packaging components. The criteria used to evaluate packaging performance is whether the contents of the packaging are retained within the outer packaging, should damage to the outer packaging occur, and secondly, if any inner packaging of hazardous materials leaks, ruptures, or is damaged so as to affect transportation safety. The successful completion of the required tests does not ensure the undamaged delivery or survivability of the actual commodity/item. Separate testing is necessary to assure the stability of any explosive item.

Before a configuration can be certified by the person(s) authorizing shipment, the appropriate packaging for the particular hazardous materials and mode of transportation must be determined, and the item(s) must be prepared for shipment per applicable regulations. The chosen configuration must have been performance tested in accordance with the size, the shape, and the weight constraints posed by the configuration to be certified. The testing reported herein should not be construed as blanket certification of any configuration that simply uses the performance tested outer drum. Packaging paragraphs apply.

*Absorbent DOES NOT meet the minimum measurement requirements of AFIMAN 24-204.

Appendix B**Test Data Sheet**

Section I. Test Product
Stacking Weight Formula, DLA COMBINATION PACAGINGS

Variables	Inputs	
h height, drum/box	20.5	
n # stacked containers	XXXXXXXXX	5.80
w1 weight, drum/box	9.2	
w2 weight, bottle/can, filled	2.32	
w3 weight, ring/pad	0	
q1 # inner containers	6	
v1 max. volume, 1 inner container	.25	
v total volume	XXXXXXXXX	1.50
w4 weight, item (unpacked)	0.00	
W5 weight, absorbent	13.00	
W gross weight	XXXXXXXXX	36.12
C constant	1	
sg specific gravity	1.2	
PG Packing Group	I	

NOTE: A11 = $(n-1) * (w + (1.2 * v * 8.3 * 0.98)) * (c)$, Packing Group I
A21 = $(n-1) * (w + (1.8 * v * 8.3 * 0.98)) * (c)$, Packing Group II
A31 = $(n-1) * (w + (2.7 * v * 8.3 * 0.98)) * (c)$, Packing Group III

$n = (118/h)$, minimum number of containers that when stacked, reach a height of 3 m

$w = w1 + (w2 * q1) + (w3 * q1) + w4$, total weight in pounds

$v = v1 * q1$, total volume

C = either 1.5 (the compensation factor that converts the static load of the stacking test into a load suitable for dynamic compression testing),
or 1.0 (static top load)

A11	Stacking weight, rounded -PG I	XXXXXXXXX	244
A21	Stacking weight, rounded -PG II	XXXXXXXXX	279
A31	Stacking weight, rounded -PG III	XXXXXXXXX	332

Appendix B (Continued)**Section III. Equivalencies of Liquids**

	Specific Gravity ¹	Total (Each) Amount per Container		Gross Weight (pounds) (kilograms)	
water*	1.0	12.5	lb	36	16
PG I	1.2	15	lb	39	18
PG II	1.8	23	lb	47	21
PG III	2.7	34	lb	58	26

Note 1. Equivalent specific gravity derived from drop height as follows-- PG factor x density (or SG) = drop height, thus

SG = drop height/PG factor (49 CFR §178.603)

PG I: 1.5 m x SG = 1.8 m, thus SG = 1.2

PG II: 1.0 m x SG = 1.8 m, thus SG = 1.8

PG III: 0.67 m x SG = 1.8 m, thus SG = 2.7

Unless otherwise computed for more dense liquids, water (SG = 1) represents a solution having a specific gravity of 1.2 or less.

Appendix C

Packaging Data Sheet


Section I. Exterior Shipping Container

Packaging Category: single X combination composite

UN Type: Steel open head drum (49 CFR §178.504)

UN Code: 1A2 Nominal (Rated) Capacity: 7 gal

UN Marking(s) on Packaging:

label on drum side--  1A2/X120/S/04/USA/M4492

stencil on drum side-- Air eligible to a minimum of 100 kPa

embossed on drum bottom-- UN/1A2/X120/S/04
.9-.7-.7

Specification Type and No.(s): N/A

Type/Materials: Steel, open head drum

Manufacturer/Distributor: Myers Container Corp., Emeryville, CA
94608 CAGE: 20327

Date(s) of Manufacture: 2/04

Nomenclature: Drum, Steel, Shipping and Storage

NSN: 8110-00-254-5714 (drum assembly)

Tare Weight (empty drum): 9.2 lbs.

Dimensions:

20½ in. OD (drum height, including locking ring)

11½ in. OD (drum body diameter, outside ring)

10³/₈ in. ID (drum body diameter)

19 $\frac{3}{4}$ in. ID (drum body height)

Closure (Method/Type): Gasket with bolted locking ring assembly

Closing Instructions: Tap ring while tightening bolt to 60 ft-lbs or when lugs touch.

Appendix C (Continued)

Section II. Inner Packaging/Article

Quantity of Inner Containers: 6 Capacity: .25 gallon

Specification Type and No.(s): N/A

Type: Round, metal can, cone top

Manufacturer/Distributor: Freund Container Inc., Chicago, IL, P/N: 1915

Material(s): tin plate steel

Date of Manufacture: N/A

Tare Weight (empty container): 0.24 lb

Filled Weight: 2.32 lbs.

Dimensions: 3¾ dia. X 7¼ in. high

Closure (Method/Type): Metal screw cap with vinyl & pulp liner

Closure Specification Number(s): N/A

Closure Manufacturer: N/A

Closure Dimensions: 1⅞ in. diameter X ½ in. ht.

Secondary Closure: Two pieces of tape crossed over cap and down the sides,
1-inch pressure sensitive, filament-reinforced tape
IAW ASTM 5330, TY II (medium tensile)

Polyethylene Liner Bag: 30" x 36" x .004"

Absorbent Material: HAZMAT PAC A-900 was used, Absorbent GP or fine grain
vermiculite can be substituted.

Absorbent Material Weight: 13 lbs cellulose fiber absorbent
7 lbs fine grain, vermiculite

Absorbent Manufacturer: HAZMAT PAC Co., Houston, TX 77023

Appendix C (Continued)

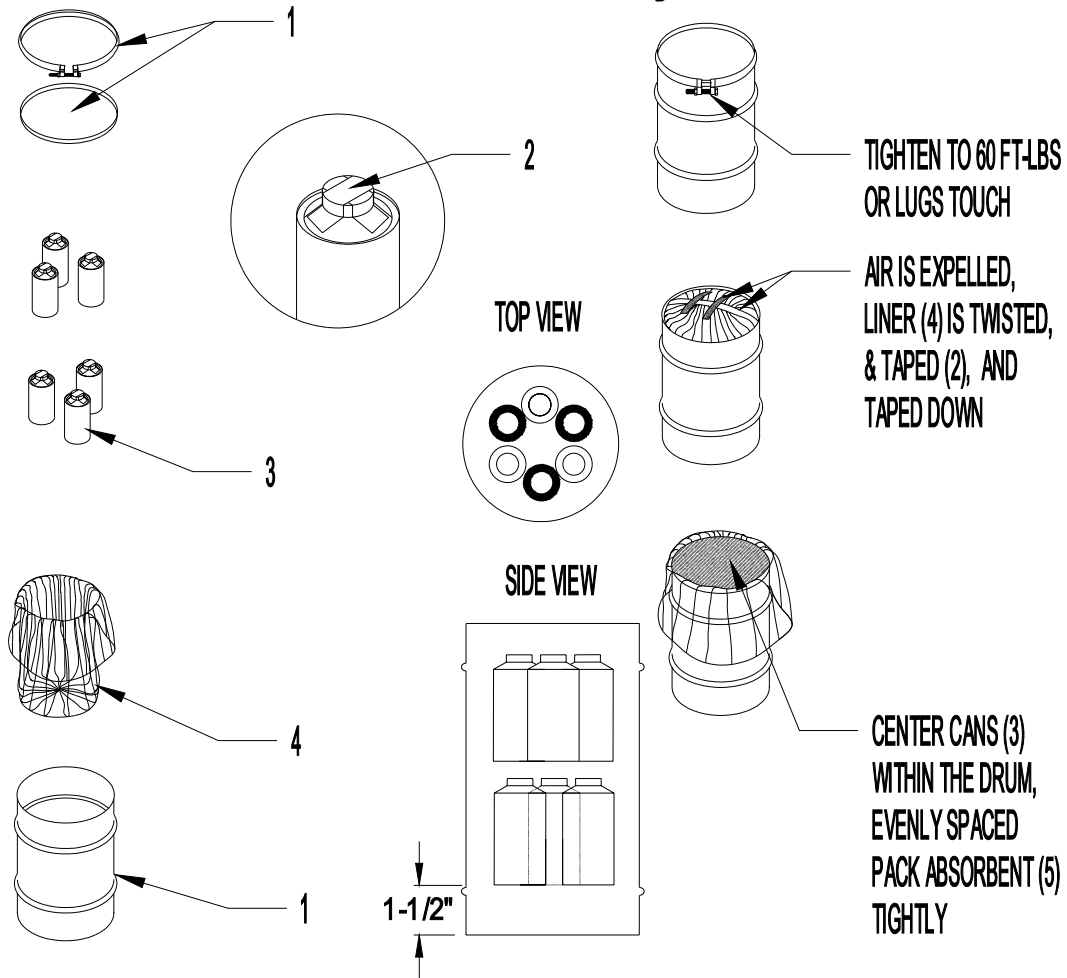
Section II. Inner Packaging/Article (Continued)

Additional Description:

a. A plastic liner bag, 30" x 36" x .004", was first placed into the drum to encapsulate the absorbent and test product.

b. Approximately 1½ inches of loose fill absorbent was compressed in the bottom of the drum, also between tiers. Three inner containers were placed on the compressed absorbent cushioning, evenly spaced around center. Additional loose fill absorbent was then tightly packed around and 1½ inches over the inner containers, then the next three cans were placed between the cans of the first tier. It is critical that the full amount of absorbent is used and compressed approximately every 4 inches as the drum is being packed. The loose fill absorbent must completely fill the drum, up to the rim. The plastic bag is to be twisted and then taped closed (see drawing).

Appendix D
Drawing



ITEM	DESCRIPTION	04D024
1	7-GAL., DRUM, METAL-SHIPPING & STORAGE, OPEN HEAD, IAW MIL-D-6054, NSN: 8110-00-254-5714, MS27684-5	
2	1-INCH WIDE, PRESSURE-SENSITIVE TAPE, FILAMENT-REINFORCED, IAW ASTM D5330, TY II	
3	1-QUART, CAN, METAL, ROUND, CONE TOP AND SCREW CAP, QTY. 6	
4	4 MIL, POLYETHYLENE BAG, 30" X 36", QTY.1	
5	CELLULOSE FIBER ABSORBENT(13 LBS), OR VERMICULITE(7 LBS), A-A-52450	

Appendix D (Continued)



Intermediate and Exterior Shipping Container.

Appendix D (Continued)



Inner Shipping Container with Secondary Closure (Tape) and Outer Container.

Appendix D (Continued)



Intermediate Shipping Container Twisted and Taped.